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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • • ORGANISATION INTERNATIONALE DE NORMALISATION

Space systems — Fluid characteristics, sampling and test methods —

Part 5:
Nitrogen tetroxide propellants

Systèmes spatiaux — Caractéristiques des fluides, échantillonnage et méthodes d'essai —
Partie 5: Peroxyde d'azote (carburant)

ICS 49.140

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matter

Introduction

This International Standard specifies limits for the composition of nitrogen tetroxide (N_2O_4)-based propellants and establishes the fluid sampling and test methods for nitrogen tetroxide-based propellants intended for use as an oxidizer in propellant systems of space systems. The purpose of this International Standard is to establish uniform requirements for sampling and test methods for nitrogen tetroxide-based propellants used in the servicing of launch vehicles, spacecraft, and ground support equipment.

Fluid operations at a spaceport or launch site may involve a number of operators and supplier/customer interfaces, from the fluid production plant to the delivery to the launch vehicle or spacecraft. The fluid composition limits specified in this International Standard are intended to define the purity and impurity limits of the fluid for loading into the launch vehicle or spacecraft. The fluid sampling and test methods included in this International Standard are intended to be applied by any operator. The fluid sampling and test methods presented in this International Standard are acceptable methods for verification of the fluid composition limits.

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Part 5:
Nitrogen tetroxide propellants

1 Scope

This part of ISO 15859 specifies limits for the chemical composition and physical properties of nitrogen tetroxide (N_2O_4)-based propellants and defines the fluid sampling and applicable test methods for verification of nitrogen tetroxide composition. This International Standard establishes acceptable test and sampling requirements. This part of ISO 15859 is applicable to N_2O_4-based propellants of the following types and grades, intended for use as an oxidizer in propellant systems of space systems.

CAUTION — Nitrogen tetroxide-based propellants, in the liquid or vapor form, are toxic and volatile. Care should be taken in the handling and storage of nitrogen tetroxide to prevent contact with the human body and with materials that are not compatible with nitrogen tetroxide.

- Types
  - NTO: N_2O_4 purity with red-brown colour;
  - MON-1: N_2O_4 and NO with green colour;
  - MON-3: N_2O_4 and NO with green colour;
  - MON-10: N_2O_4 and NO with green colour;
  - MON-25: N_2O_4 and NO with green colour;
- Grades
  - standard: no iron requirement;
  - low-iron: 0,5 μg/g iron maximum.

This part of ISO 15859 is applicable to propellant used in both flight hardware and ground facilities, systems, and equipment. It is applicable to influents only to the extent specified herein.

This part of ISO 15859 is applicable to any sampling operation required to ensure that, when the fluid enters the launch vehicle or spacecraft, the fluid composition complies with the limits provided hereafter or with any technical specification agreed to for a particular use.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 15859. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 15859 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 8402:1994, Quality management and quality assurance – Vocabulary

3 Terms and definitions

For the purposes of this part of ISO 15859, the terms and definitions given in ISO 8402 and the following apply.

3.1
particulate matter
undissolved solids retained on a filter paper with a 10 μm nominal and 40 μm absolute rating

3.2
verification tests
analyses performed on the fluid in the container, or a sample thereof, which is representative of the supply

4 Chemical composition and physical properties

4.1 Limits

Unless otherwise provided in an applicable technical specification, the chemical composition and physical properties of N_2O_4-based propellants delivered to the flight vehicle interface shall be in accordance with the limits given in Table 1 when tested in accordance with the applicable test methods.

Table 1 — Composition limits

Composition			Limits				
			NTO (red-brown)	MON-1 (green)	MON-3 (green)	MON-10 (green)	MON-25 (green)
N_2O_4 assay	mass fraction, %, min.		99,5	—	97,0	88,8	—
Nitric oxide (NO) content	mass fraction, %	max.	[a]	1,0	3,0	11,0	26,0
		min.	[a]	0,6	1,5	10,0	25,0
N_2O_4 + NO	mass fraction, %, min.		—	99,5	99,5	—	99,5
Water equivalent	mass fraction, %, max.		0,17	0,17	0,20	0,20	0,17
Chloride content	mass fraction, %, max.		0,040	0,040	0,040	0,040	0,040
Nonvolatile residue[b]	mg/L, max.		—	10,0	10,0	10,0	10,0
Iron content[b]	μg/g, max.		—	0,5	1,0	1,0	0,5
Particulate matter	mg/L, max.		10,0	10,0	—	—	10,0

[a] The NO content shall be limited to that which does not change the specified red-brown colour of the propellant.

[b] This requirement applies to the low-iron grade of the propellant only.

5.5 Sample size

The quantity in a single sample container shall be sufficient to perform the analysis for the limiting characteristics. If a single sample does not contain a sufficient quantity to perform all of the analyses for the required quality verification test, additional samples shall be taken under similar conditions.

5.6 Number of samples

The number of samples shall be in accordance with one of the following:

a) one sample per storage container;

b) any number of samples agreed upon by the supplier and the customer.

5.7 Storage container

Unless otherwise provided by the applicable sampling plan, the fluid storage container shall not be refilled after the time the sample is taken.

5.8 Liquid samples

Liquid samples shall be a typical specimen from the liquid

a) purity and impurity contents shall be expressed as a percentage (%) by weight unless otherwise specified;

b) calibration standards containing the applicable liquid components may be required to calibrate the analytical instruments used to determine the limiting characteristic levels of fluid;

c) if required by the customer, the accuracy of the measuring equipment used in preparing these standards shall be traceable to an established institute for standards;

d) analytical equipment shall be operated in accordance with the manufacturer's instructions;

e) analytical methods not listed in this International Standard are acceptable if agreed upon between the supplier and the customer.

6.3 Nitrogen tetroxide purity

The nitrogen tetroxide concentration shall be determined by the following methods:

a) a sample of the nitrogen tetroxide is placed in a preweighed ampoule, sealed, and weighed. The ampoule is transferred to a sturdy glass bottle or flask containing 100 mLof demineralized water and 20 mLof a 30 % hydrogen peroxide solution and the container is sealed. The container is chilled and shaken to break the

c) by a coulometric method (for water equivalent only).

6.6 Nitrogen tetroxide and nitric oxide content

The nitrogen tetroxide and nitric oxide content shall be determined by adding the nitrogen tetroxide concentration and the nitric oxide content together.

6.7 Chloride content

The chloride content shall be determined by one of the following methods:

a) by a silver nitrate titration potentiometric method;

b) by a colorimetric method;

c) by an ion chromatographic method;

d) by a potentiometric method using a chloride-specific electrode.

All these methods shall not be used directly on the liquid N_2O_4 sample but after dissolving it in an aqueous solution